WHAT ARE JOIST GIRDERS?

Joist girders are primary framing members. The design is simple span, supporting equally spaced concentrated loads from open web steel joists. These concentrated loads are considered to act at the panel points of the joist girder.

Joist girders are designed to allow for the efficient use of steel in longer spans for primary framing members.

The following weight tables list joist girders from 20" to 96" deep and spans up to 100 feet. (For depths and lengths not listed contact Vulcraft.) The depth designation is determined by the nominal depth at the center of the span, except for offset double pitched girders, where the depth is determined at the ridge.

The standard configuration of a joist girder is parallel chord with underslung ends and bottom chord extensions. (Joist girders can be furnished in other configurations, see below.) The standard depth of bearing for joist girders is 7 1/2 inches at the end of the bearing seat.*

The standard method of connecting girders to columns is two 3/4" diameter A325 bolts. A loose connection of the lower chord to the column or other support is required during erection in order to stabilize the lower chord laterally and to help brace the joist girder against overturning. **CAUTION: IF A RIGID CONNECTION OF THE BOTTOM CHORD IS TO BE MADE TO COLUMN OR OTHER SUPPORT, IT IS TO BE MADE ONLY AFTER THE APPLICATION OF THE DEAD LOADS. THE JOIST GIRDER IS THEN NO LONGER SIMPLY SUPPORTED AND THE SYSTEM MUST BE INVESTIGATED FOR CONTINUOUS FRAME ACTION BY THE SPECIFYING PROFESSIONAL.**

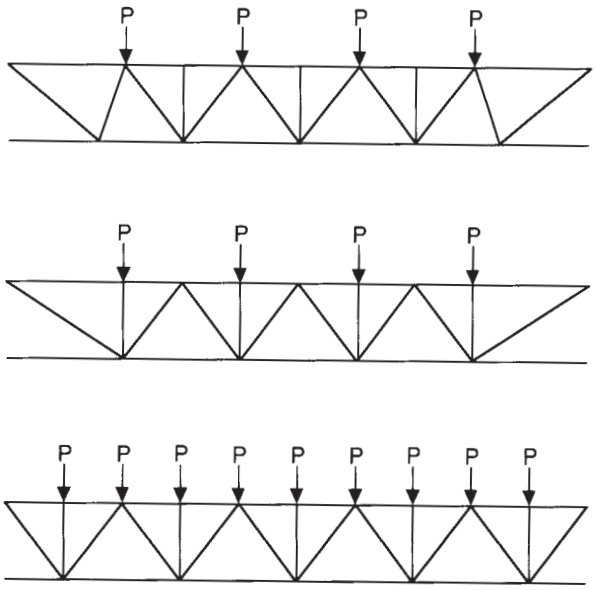
Joist girders along the perimeter, with joists coming in from one side only, and those with unbalanced loads must be designed such that the reactions pass through the center of the joist girder.

The weight tables list the approximate weight per linear foot for a joist girder supporting the panel point loads given by the specifying engineer. **NOTE: THE WEIGHT OF THE JOIST GIRDER MUST BE INCLUDED IN THE PANEL POINT LOAD. (SEE THE EXAMPLE ON PAGE 101).**

For calculating the approximate deflection or checking ponding the following formula may be used in determining the approximate moment of inertia of the joist girder. $I_{JG} = 0.027\ NPLd$

Where N = number of joist spaces, P = panel point load in kips, L = joist girder length in feet and d = effective depth of the joist girder in inches. Contact Vulcraft if a more exact joist girder moment of inertia must be known.

*Increase seat depth to 10" if weight of joist girder appears to the right of the stepped blue lines in the weight tables.



G TYPE

VG TYPE

BG TYPE

OTHER CONFIGURATIONS AVAILABLE ARE:

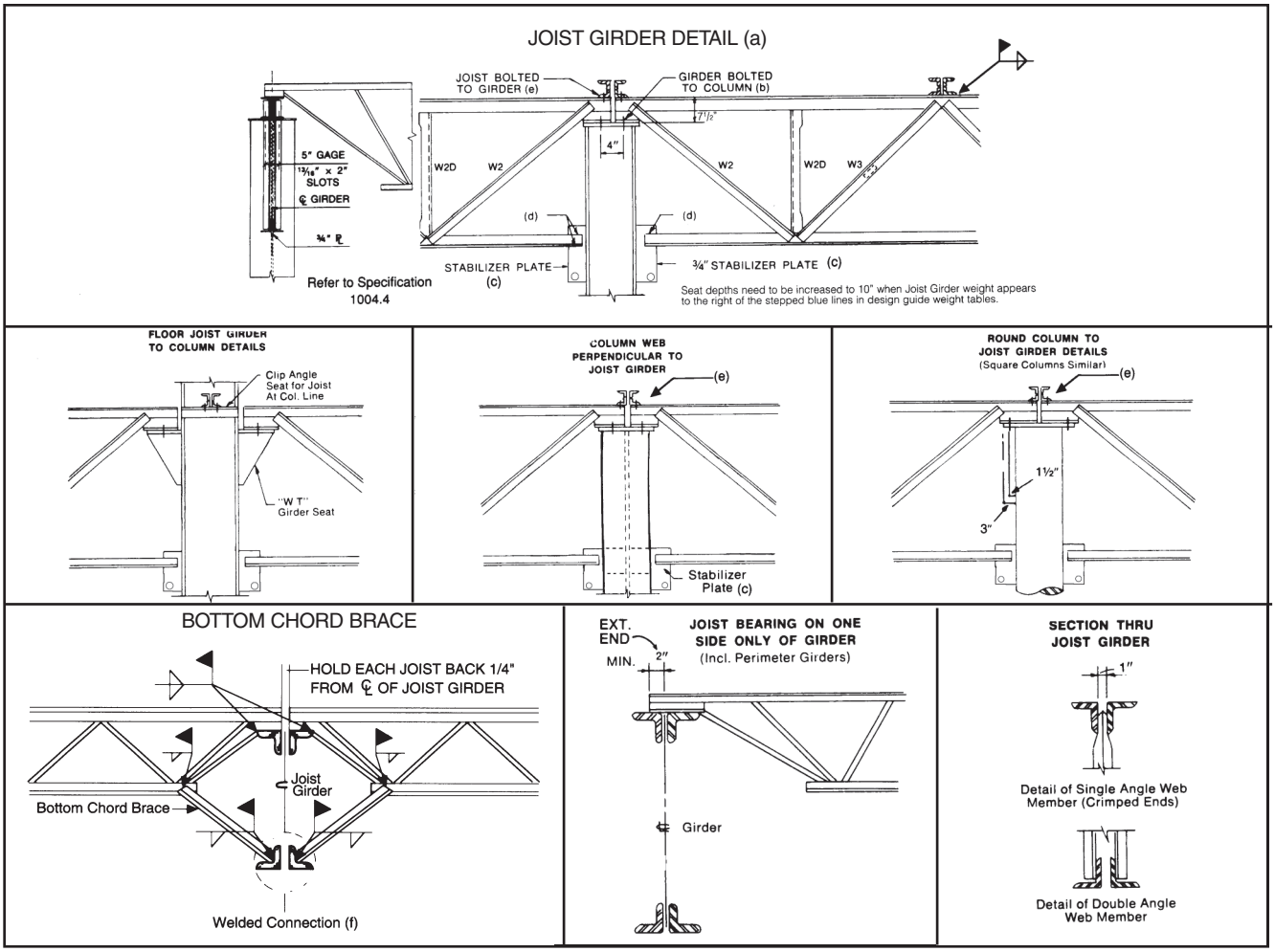
DOUBLE PITCH TC, UNDERSLUNG

SINGLE PITCH TC, UNDERSLUNG

OFFSET DOUBLE PITCH TC, UNDERSLUNG

SEE PAGE 101
FOR DESIGN EXAMPLE

NOTE: JOIST GIRDER WEB CONFIGURATION MAY VARY FROM THAT SHOWN. IF EXACT CONFIGURATION IS REQUIRED CONTACT VULCRAFT.



SEE PAGE 93 FOR MOMENT CONNECTION DETAILS

JOIST GIRDER NOTES

(a) All Joist Girder dimensions shown are subject to change when required by the physical size of large Joist Girders. If changes are necessary Vulcraft will so note on the placement plans.

(b) The standard connection for Joist Girders to columns is 13/16 inch slots for 3/4 inch bolts in girder bearings. **The girder erection bolts are by others.** If the specifying professional wishes to use the Joist Girder bearing to transmit horizontal loads, the required amount of weld to connect the Joist Girder seat to the column should be specified. For additional information see the section of this catalog "JOIST GIRDERS IN MOMENT RESISTIVE FRAMES." (page 92)

(c) Stabilizer plates between bottom chord angles stabilize the bottom chord laterally and brace the Joist Girder against overturning during erection. (Refer to 1004.4)

(d) Joist Girder bottom chord struts do not require welding to the stabilizer plate unless required by design to transmit horizontal forces. When welding is required, the amount of weld should be specified by the specifying professional. UNLESS OTHERWISE SPECIFIED, BOTTOM CHORD STRUTS SHOULD NOT BE WELDED.

(e) Joists are connected to the girder by welding except that the joists at (or nearest) the column shall also be bolted (O.S.H.A. Sec. 1910.12 Construction Standards Sec 1518.751).

(f) The l/r_y of the bottom chord of the Joist Girder cannot exceed 240. For STANDARD Joist Girders, the specifying engineer can use the "Joist Girder Bottom Chord Brace Chart" in conjunction with the "Design Guide Weight Table/Joist Girders, G Series" to select the correct number of bottom chord braces. Joist Girders which must resist uplift, end moments, or axial bottom chord forces may require additional braces.

JOIST GIRDER NOTES

If fixed end moments or uplift are present, the specifying professional should also specify bottom chord braces to be designed and furnished by the joist girder manufacturer. If any additional braces are required due to the compression load in the bottom chord, Vulcraft will indicate their location on the placement plans. Bottom chord braces may be either welded or bolted to the girder, but are typically welded to the joist.

JOIST GIRDER BOTTOM CHORD BRACE CHART*			
	SPAN IN FEET		
JOIST GIRDER WEIGHT/FT	NO BC BRACES	ONE BC BRACE @ CENTERLINE	TWO BC BRACES @ 1/3 POINTS
0-22	0' to 24'	>24' to 49'	>49' to 73'
23-30	0' to 28'	>28' to 57'	>57' to 85'
31-45	0' to 32'	>32' to 65'	>65' to 97'
46-66	0' to 36'	>36 to 73'	>73' to 110'
67-87	0' to 41'	>41' to 82'	>82' to 123'
88-135	0' to 49'	>49' to 98'	>98' to 147'
136-173	0' to 57'	>57' to 114'	>114' to 171'

* The bottom chords must be restrained in accordance with Section 1004.5 of The SJI Specifications.

ECONOMY TIPS

1. Designate Joist Girder with exact load required, such as 60G8N11.2K.
2. If Joist Girder depth is limited below the optimum depth as shown in the weight tables, use the maximum depth permitted by the building system: such as 53G8N12K (odd depths can be designed and furnished).
3. The Joist Girder designations shown in the weight guide are typical types included only as a guide. The specifying professional is encouraged to specify the exact depth, span and loading that best suits the building.
4. A Joist Girder depth in inches approximately equal to the span in feet is often a good combination for economy.
5. The specifying professional is urged to investigate several combinations of bay sizes and joist spaces to find the most economical combination.
6. The following table illustrates the economy possible using this system.

Table G-1 ROOF SYSTEM WEIGHT FOR RECOMMENDED BAY SIZES							
BAY SIZE		Weight of joists* + Girders** = Total (PSF)***					
Joist Span	Girder Span	Design Load (PSF) 35 (PSF)	40 (PSF)	45 (PSF)	50 (PSF)	Joist Space (Ft.)	Girder Depth (In.)
40'	40'	1.69 + .75 = 2.44	1.78 + .83 = 2.61	1.90 + .90 = 2.80	2.07 + 1.03 = 3.10	6.67	48
40'	50'	1.73 + .95 = 2.68	1.90 + 1.08 = 2.98	2.02 + 1.18 = 3.20	2.13 + 1.28 = 3.41	6.25	60
40'	60'	1.69 + 1.13 = 2.82	1.78 + 1.30 = 3.08	1.90 + 1.40 = 3.30	2.07 + 1.53 = 3.60	6.67	72
45'	40'	1.89 + .71 = 2.60	2.04 + .80 = 2.84	2.14 + .89 = 3.03	2.41 + .96 = 3.37	6.67	48
45'	50'	1.98 + .96 = 2.94	2.11 + 1.09 = 3.20	2.22 + 1.16 = 3.38	2.40 + 1.29 = 3.69	6.25	60
45'	60'	1.89 + 1.16 = 3.05	2.04 + 1.24 = 3.28	2.14 + 1.38 = 3.52	2.41 + 1.49 = 3.90	6.67	72
50'	40'	2.19 + .72 = 2.91	2.28 + .80 = 3.08	2.53 + .86 = 3.39	2.80 + 1.06 = 3.86	6.67	48
50'	50'	2.21 + .92 = 3.13	2.43 + 1.00 = 3.43	2.61 + 1.12 = 3.73	2.70 + 1.20 = 3.90	6.25	60
50'	60'	2.19 + 1.12 = 3.31	2.28 + 1.22 = 3.50	2.53 + 1.34 = 3.87	2.80 + 1.50 = 4.30	6.67	72

* Weight of joists in pounds per square foot.
** Weight of the joist girders in pounds per square foot.
*** Total weight of joists and joist girders in pounds per square foot.

The larger bay sizes become more economical as the column heights increase and in localities with high erection labor costs. Larger bays speed construction by reducing the number of pieces and therefore the number of crane lifts. Encasing the columns for fire proofing or decoration also makes the larger bays more attractive.

When a Joist Girder is used as a component of a moment resistive frame, both the design wind moment and any continuity (usually live load) moment must be specified for each end of each affected Joist Girder. Provided this information, Vulcraft will design the Joist Girder as a simply supported truss for full gravity loading. The "fixed end" moments are then applied to the Joist Girder. Using the appropriate combinations of the gravity loads, the wind moments, and/or the continuity moments, the critical member stresses are identified and the Joist Girder members are sized accordingly.

The Specifying Professional shall clarify when allowable stresses are permitted to be increased or load combinations reduced. **(Vulcraft does not design the Joist Girder for any dead load moments unless specifically instructed to do so on the structural drawings.)** For this reason it is very important that on the structural drawings the specifying professional specify that all dead loads be applied to the Joist Girders before the bottom chord struts are welded to the stabilizer plates.

One of the most important considerations of using a Joist Girder in a moment resistive frame is the connection of the Joist Girder to the column. As with a beam connection, special provisions must be made to develop the required moment capacity. As can be readily seen in Figure 1, the use of a standard Joist Girder seat results in an eccentric moment due to the depth of the seat. This moment must be resisted by the weld group connecting the Joist Girder seat to the cap plate of the column.

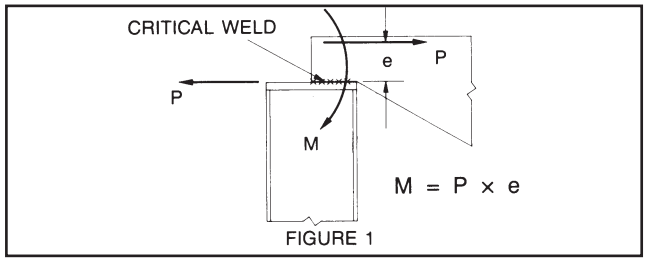


FIGURE 1

Vulcraft has done extensive testing of the maximum eccentric top chord force capacity for joist girders. Based on this test program, the maximum horizontal load for 7.5 inch deep seats are presented in Table 1 (below)

Joist Girder (7.5″ Seat) Top Chord Leg Size	ASD P_a * kips	LRFD ϕP_n * kips
2.5″	4	6
3.0″	8	12
3.5″ and larger	10	15

Table 1

*These values are based on using 3/4 inch A325 bolts and a minimum of two 1/4 inch fillet welds 5 inches long along the sides of the seat. Vulcraft must be notified of seat forces for final seat design.

If the axial load due only to the wind moment does not exceed the values in Table 1, a strap angle connecting the Joist Girders together as shown in Figure 2 can be used to resist the continuity moments, By tying the Joist Girder ends together, the Joist Girder-to-cap plate connection need only resist the wind loads, **the strap angles do not transfer wind moments**. The design of such a strap angle to resist the continuity moments is the responsibility of the specifying professional.

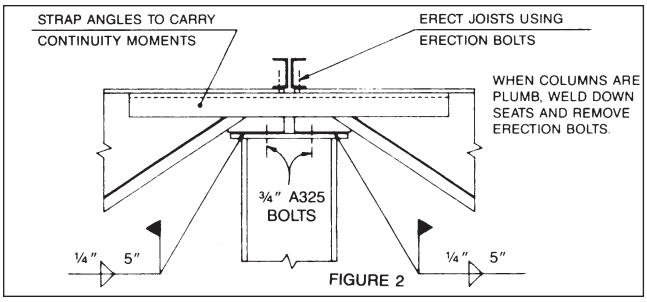


FIGURE 2

When the end moments on the Joist Girders are too large for the seat to resist, it is necessary to utilize a moment plate as shown in Details A-F. The use of this simple moment plate virtually eliminates all eccentricity problems.

By using the equations and Table 2 below, the specifying professional can determine the minimum Joist Girder top chord width for most Joist Girders. If the end moments are very large, the Joist Girder loads and/or spacings vary, or other special conditions exist, a more exact analysis is required. Once the Joist Girder top chord width is known, the specifying professional can easily size the moment plate and its weld requirements to complete the connection detail.

EQUATION 1 (ODD NO. OF JOIST SPACES)

$$A = \frac{.028P}{D}(N^2S - .67N + .67 - S)$$

EQUATION 2 (EVEN NO. OF JOIST SPACES)

$$A = \frac{.028P}{D}(N^2S - .67N + .67)$$

Where:
P = Panel point load (kips)
N = No. of joist spaces
S = Joist spacing (ft.)
D = Joist Girder depth (in.)

Table 2*

A	Minimum Top Chord Width
0.95 - 1.19	6"
1.20 - 1.78	7"
1.79 - 2.48	8"
2.49 - 3.75	9"
3.76 - 4.76	11"
4.78 - 8.44	13"
Greater than 8.44	Consult Vulcraft

Please note that this chart is to be used only for designing moment plates. It is not intended for use as a general detailing aid.

*The bearing seat width may be larger than the top chord width. Contact Vulcraft if seat width is needed for determining column plate sizes.